Referring to FIG. 2D, a native oxide film is removed with an HF cleaning process. During the HF cleaning process, since an etching speed of oxide films for the third interlayer insulating film 350 and the fourth interlayer insulating film 360 are higher than a nitride film for the etching stopper 355, an open area of the storage node contact 365a after the HF cleaning process is larger than that of the storage node contact 365 after the dry etching process. Thus, the nitride film for the etching stopper 355 protrudes from the sidewall of the storage node contact 365a.

FIG. 3A is a plan diagram illustrating the semiconductor device after the storage node contact 365a is formed by the HF cleaning process. FIG. 2C is a cross-sectional diagram taken along a line IID-IID of FIG. 3A after the HF cleaning process.

A first polysilicon film 380 is deposited to a thickness of 200 ~ 400 Å on the substrate including the storage node contact 365a. It is desirable that the first polysilicon film 380 is deposited to its minimum thickness in order not to fill the storage node contact 365. It is because it is for forming a void at the bottom of the storage node contact 365a and then forming a recess at an upper surface of a sacrificial insulating film during the deposition of a sacrificial insulating film for forming a storage node.

Referring to FIG. 2E, a sacrificial insulating film 390 is formed to a thickness of about 10000 ~ 15000 Å on the substrate. The sacrificial insulating film 390 uses an insulating film that copies an undulation produced by the storage node contact 365a on its upper surface. The insulating film may be, for example, a plasma oxide film PEOX, or a high density plasma oxide film.

At this time, in the storage node contact 365a, the first etching stopper 355 is protrudes more than the third and fourth interlayer insulating films 350 and 360. Thus, a void ~~381~~ 391 is formed at the bottom of the storage node contact 365a. As a result, the undulation produced by the storage node contact 365a is copied on the sacrificial insulating film 390. Accordingly, the sacrificial insulating film 390 has a recessed portion 395 on its surface corresponding to the storage node contact 365a.

Next, an insulating film 400 is deposited to a thickness of 500 ~ 1000Å on the sacrificial insulating film 390. A nitride film that may gap fill the recessed portion 395 of the sacrificial insulating film 390 and has a wet and dry etching selectivity with respect to the sacrificial insulating film 390 is used as the insulating film 400.

Referring to FIG. 2F, the insulating film 400 is etched by a CMP process using the sacrificial insulating film 390 as an etching end point until a portion of the sacrificial insulating film 390 is exposed. Thus, the insulating film 405 fills in the recessed portion 395

etching the first etching mask material to remain at the recessed portion of the second insulating film.

6. The method according to claim 5, wherein etching the first etching mask material comprises etching with a CMP process that uses the second insulating film as an etching end point.

7. The method according to claim 5, wherein forming the etching mask layer on the recessed portion further comprises:

dry-etching the second insulating film using the first etching mask material;

wet-etching the second insulating film using the first etching mask material;

depositing a second etching mask material on the substrate; and

etching the second etching mask material to remain on an edge portion of the first etching mask material.

8. The method according to claim 7, wherein the second etching mask material acts as a support for the first etching mask material.

9. The method according to claim 7, wherein etching the second etching mask material comprises etching with an etch back process that uses the second insulating film as an etching end point.

10. The method according to claim 7, wherein the second insulating film comprises an oxide film and the first and second etching mask materials comprise a nitride film.

11. The method according to claim 7, wherein a surface dimension of the storage node is determined by a deposition thickness of the second etching mask material.

12. The method according to claim 7, wherein the second insulating layer is etched to a thickness of about 100Å to 300Å within the extent that the first etching mask material is not lifted.

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13. The method according to claim 1, wherein etching the second insulating film using the etching mask layer comprises etching until the first conductive film for a storage node is exposed.

14. The method according to claim 1, wherein forming the first conductive film for a storage node comprises forming a conductive material to a minimum thickness, B preferably about ~~200 to 400Å~~, so as not to completely fill the storage node contact.
200Å to 500Å